

MBIO 2230: Introductory Biogeochemistry

Biogeochemistry is the study of how the composition of environments is shaped by the interactions among **biological**, **geological** and **chemical** forces. Selected topics for this course include: nutrient cycles, biotic influences on atmospheric composition, soil organic matter formation and dynamics, weathering, and redox potential. Microorganisms will be emphasized as major drivers of biogeochemical processes.

Instructor: Dr. Matthew Bakker; Matthew.Bakker@umanitoba.ca

Dates: 9 September – 23 December 2020

Class times: MWF 12:30-1:20 pm

Despite the scheduled time, this course is being offered in a remote learning format, as part of the University's efforts to prevent the spread of COVID-19. Course content will be provided in instalments throughout the term, via UM Learn. Most of the time, it will be fine to work through the material at a time convenient for you. However, there will be several times when I ask you to be present concurrently during the scheduled class period.

Technology requirements: A computing device where one can create and edit documents, an internet connection capable of streaming videos and downloading software, and access to a web-cam and microphone.

Course credits: 3.00

Prerequisites: One of: MBIO 1010, MBIO 1011, BIOL 1030, BIOL 1031

And: CHEM 1310 or CHEM 1311

A minimum grade of 'C' is required in each prerequisite.

Text: *Biogeochemistry: An Analysis of Global Change. 4th edition.*
by W.S. Schlesinger & E.S. Bernhardt; ISBN 9780128146088
or e-book; ISBN 9780128146095

Background expected: This is a 2000 level course, which indicates that it is offered at an introductory level. Some university-level background in microbiology/biology and chemistry is required – and with more background, you will also get more out of this course!

Learning objectives: As a result of working through this course, students will be able to...

1. Demonstrate familiarity with the dominant chemical forms, and the mechanisms of exchange between chemical forms, for the major elements required by living things: carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur ('CHNOPS')
2. Demonstrate how characteristics of the atmosphere, oceans, inland freshwater bodies, and soils influence biogeochemical cycling in those environments
3. Explain the energetic constraints on the transformations between chemical forms for the major elements required by living things
4. Identify biotic and abiotic interactions and potential feedback loops involved in biogeochemical cycles
5. Apply knowledge gained in the class to examine how biogeochemical cycles are impacted by a forcing factor, whether that be anthropogenic or natural
6. Develop and articulate a thoughtful perspective on how human activities interact with biogeochemical cycling, and whether or how societies should attempt to manage these impacts

Please review the guidance for this term from the Faculty of Science! The Faculty of Science guidance follows this syllabus.

Evaluations:

Self-assessments of understanding via UM Learn (3%): I will typically post a short quiz on UM Learn that you can use to help yourself gauge which topics you understand well, and which may require additional study (scored based on completion only).

Discussion via UM Learn (2%): I will divide you among several different discussion groups to give everyone space to voice their opinion while keeping the forums manageable. You are always free to post & discuss, but there will also be times when a specific prompt is provided.

Homework assignments (2 @ 5% each, 1 @ 15%). Detailed instructions will be provided later.

Midterm exam #1 (20%): Will be available via UM Learn during the scheduled class period on October 2nd, and will include material covered through the end of September.

Midterm exam #2 (20%): Will be available via UM Learn during the scheduled class period on November 4th, and will include material covered after midterm exam #1.

On the midterm exams, some questions will measure recall of materials, while some will require critical thinking and integration of content from different lectures. These will be closed-book exams, meaning that you should not consult any reference sources while completing the exam. Respondus LockDown Browser may be used to promote academic integrity. Missed midterms will not be available for writing later. In the event that you miss a midterm, you will have to discuss with the instructor what the implications for your grade will be.

Feedback from the first midterm exam and the first assignment will be provided prior to the voluntary withdrawal date, which is 23 November 2020.

Final exam (30%) will be according to the schedule provided by the Student Records Office.

Letter grades will only be assigned at the end of the term. Letter grades are assigned taking into consideration the grade distribution in the class and the University of Manitoba's descriptors (see <http://umanitoba.ca/student/records/grades/686.html>): A+ (Outstanding), A (Excellent), B+ (Very Good), B (Good), C+ (Satisfactory), C (Adequate), D (Marginal), F (Failure).

Student responsibilities: Students are expected to complete assigned readings, participate in class discussions, take informal notes in addition to materials supplied by the instructor, provide feedback on the learning process, hand in their assignments on time, and comply with the evaluation requirements.

University policies, such as the Respectful Work and Learning Environment policy, still apply when working remotely, as do basic expectations around how students will engage with each other, and with the University. This means that when participating in classes, online meetings, etc., students are expected to behave professionally, and follow the same basic norms as they would in person. This includes being clothed, not being impaired, and participating respectfully. Don't do anything in virtual setting that you wouldn't also do in an in-person class!

Academic Dishonesty: Academic dishonesty will be met with disciplinary action. You should review statements on academic integrity, including plagiarism, cheating and examination impersonation found in the University General Calendar and the Faculty of Science website (<https://www.sci.umanitoba.ca/students/undergraduate-students/academic-resources/academic->

[integrity-2/](#)). Please view the Academic Integrity Message from Associate Dean Krystyna Koczanski : <https://youtu.be/Ok-lilm4SeE>

Reasonable Accommodation: Students with disabilities are directed to Student Accessibility Services to facilitate the implementation of accommodations.

Tentative course outline:

Introduction & the water cycle

Understanding Earth's environments: atmosphere

Understanding Earth's environments: inland waters

Understanding Earth's environments: oceans

Understanding Earth's environments: soils

Cycling of Elements: Phosphorus

Cycling of Elements: Mercury

Midterm #1

Energetics & redox reactions

Cycling of Elements: Oxygen

Cycling of Elements: Nitrogen

Cycling of Elements: Sulfur

Cycling of Elements: Carbon

Midterm #2

Integration section

Intersections among biogeochemical cycles

Human impacts & management of biogeochemical cycles

Methods in biogeochemistry

Biogeochemical changes over Earth's history

Final exam